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मानक

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“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 12545 (1988): Methodology of calculating aircraft cargo volumes [TED 14: Aircraft and Space Vehicles]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

METHODOLOGY OF CALCULATING AIRCRAFT CARGO VOLUMES

1. Scope — Covers the methodology of defining and determining the 'internal volumes' and 'maximum package size charts' of both the main deck and lower deck aircraft cargo compartments. It also states the minimum required clearance between the compartment envelope and the unit load devices (ULDs) in order to provide the maximum ULD external contour and the methodology to define the ULD internal volumes.

2. Compartment Internal Volumes

2.1 Main Deck Compartment — The internal volume of the main deck compartment may be calculated and listed as maximum usable volume provided that the bulk cargo is 'compartment restrained', that is, the floor, ceiling, sidewalls, bulkheads, nets and supporting structure are capable of withstanding the bulk cargo restraint loads associated with all flight and ground load conditions with applicable load factors, included 9 g forward emergency landing condition. If bulk cargo is not 'compartment restrained', the unit load devices (ULDs) restrained by restraint system in accordance with the relevant Indian Standards may be utilized, and the internal volume value shall be followed by an asterisk (*) mark denoting that the usable volume shall be derived from the cumulative ULD volumes as defined in 3. The following criteria shall apply to define the main deck compartment envelope limits.

2.1.1 Length — The usable compartment length shall be that length of the main deck floor which is designed to support bulk cargo, stacked over the entire floor area. If a forward barrier net is required, then only that portion of the usable floor length aft of the barrier net station shall be utilized (see Fig. 1).

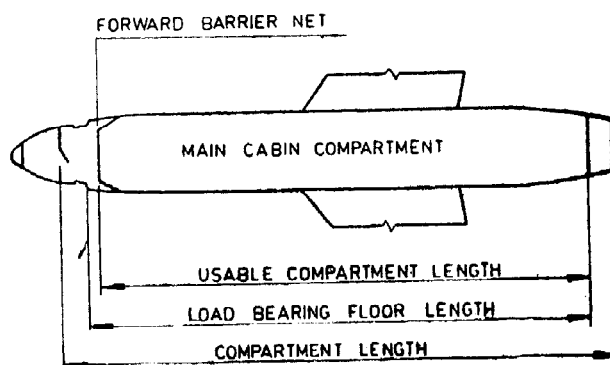


FIG. 1 MAIN DECK COMPARTMENT LENGTH

2.1.2 Height — The usable compartment height shall be the minimum height between floor or the top of the conveyor rollers and the ceiling structure or lining under which cargo must pass during loading/unloading procedures (see Fig. 8). This shall take into account mid-cabin drop ceilings. Local protrusions at either end of the compartment under which cargo may be stowed but not passed beyond shall be accounted for in calculating the internal volume, but shall not govern the compartment height. In no case shall the compartment height exceed the main deck loading doorway height (see Fig. 2).

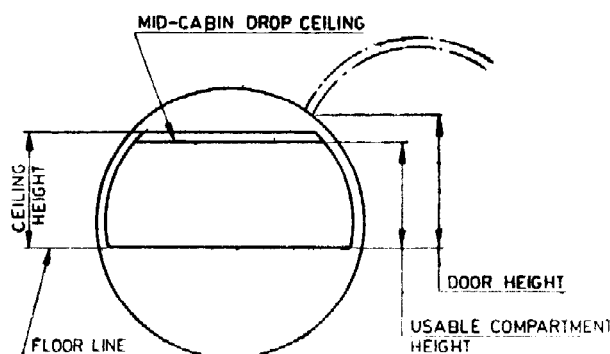


FIG. 2 MAIN DECK COMPARTMENT HEIGHT

2.1.3 Width — The usable compartment width shall be the actual cross-sectional width of the compartment provided that the sidewall liner is capable of withstanding the bulk cargo restraint loads. If the sidewall liner is not capable of withstanding this load, then only the width in board of a lateral restraint device shall be utilized (see Fig. 3).

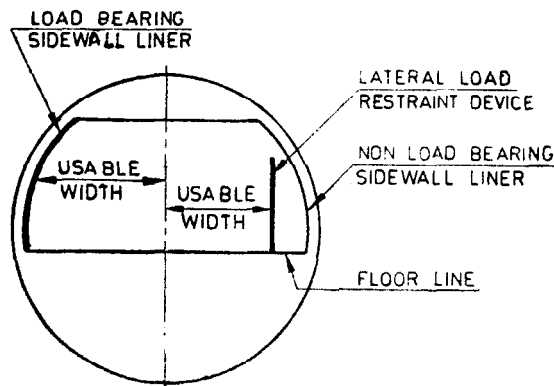


FIG. 3 MAIN DECK COMPARTMENT WIDTH

2.2 Lower Deck Compartments — The lower deck compartment internal volumes shall be calculated and listed as maximum usable volumes provided that bulk cargo is 'compartment restrained', that is, the floor, ceiling, sidewalls, bulkheads, nets and supporting structure are capable of withstanding the bulk cargo restraint loads associated with all flight and ground load conditions with applicable load factors. If bulk cargo is not 'compartment restrained', then the unit load devices restrained by restraint system as per Indian Standards may be utilized, and the internal volume value shall be followed by an asterisk (*) denoting that the usable volume shall be derived from cumulative ULD volumes as defined in 3. The following criteria shall apply to define the lower deck compartment envelope limits.

2.2.1 Length — The usable compartment length shall be that length of the lower deck floor which is designed to support bulk cargo stacked over the entire floor area. This requires that the end bulkheads are designed to withstand bulk cargo restraint loads (see Fig. 4).

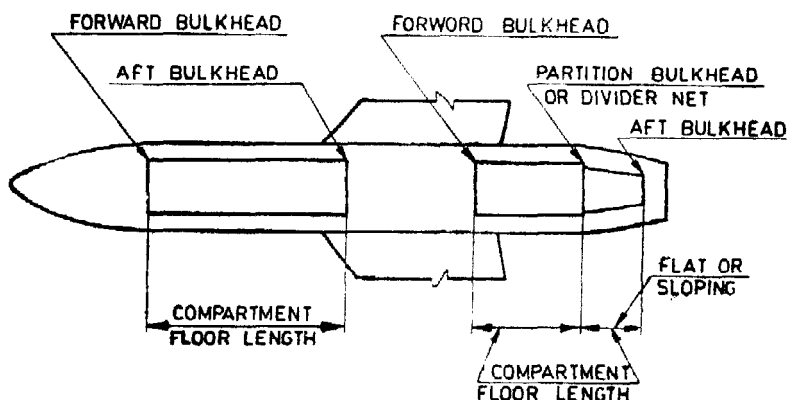


FIG. 4 LOWER DECK COMPARTMENT LENGTH

2.2.2 Height — The usable compartment height shall be the actual height between floor and ceiling surfaces, provided that both are capable of withstanding bulk cargo restraints loads. The height that a cargo loading system protrudes above the floor surface need not be discounted provided that the system is easily removed or inverted when bulk cargo is being transported. The cargo doorway height, if less than the internal compartment height, must be considered when establishing the usable height to define the maximum ULD envelope but it need not be the controlling factor to establish the usable compartment height to define the internal bulk cargo compartment volume (see Fig. 5).

2.2.3 Width — The usable compartment width shall be the actual cross-sectional width provided that the sidewall liners (vertical and sloping) are capable of withstanding bulk cargo restraint load (see Fig. 6).

2.2.4 Doorway protection — The volume lost due to installation of doorway barriers shall be accounted for in determining the internal volume, by assuming planes between floor, ceiling and sidewall which encompasses all of the barrier tie-down/attach points.

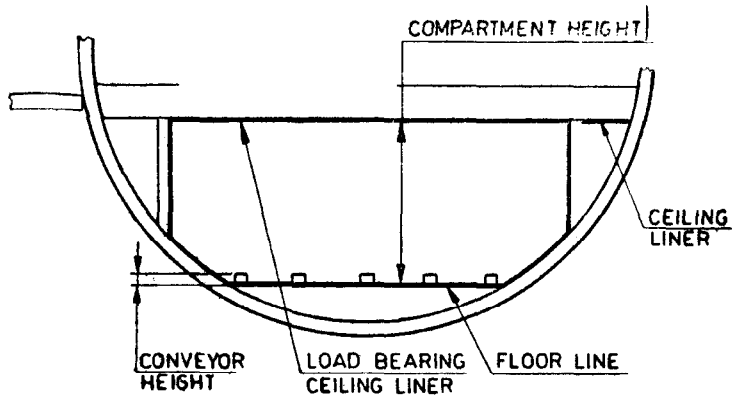


FIG. 5 LOWER DECK COMPARTMENT HEIGHT

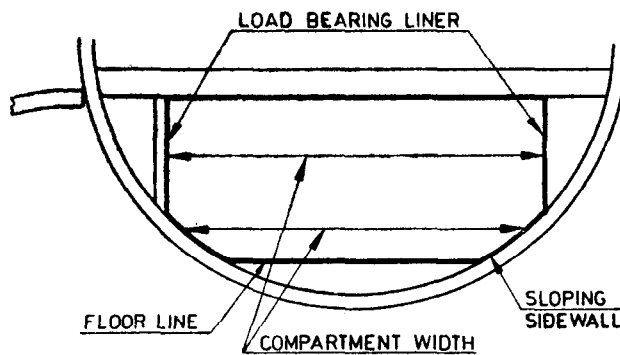


FIG. 6 LOWER DECK COMPARTMENT WIDTH

3. Unit Load Devices Envelopes

3.0 General

3.0.1 Unit load devices which when restrained by restraint system in accordance with the relevant Indian Standards, the ULDs and its contents are restrained for all flight and ground loads factors including the 9 g forward emergency landing condition. These ULDs are referred to as certified ULDs but may be utilized as non-certified ULDs.

3.0.2 Cargo may be carried in ULDs which are not restrained by an aircraft restraint system, that is, without consideration of Indian Standards, but rather by the cargo compartment enclosure. These ULDs are referred to as non-certified.

3.0.3 The allowable clearance between aircraft interior and ULDs are shown in Fig. 7 and shall be based upon the minimum cross-section of the aircraft through which or in which the ULD will traverse or be stowed.

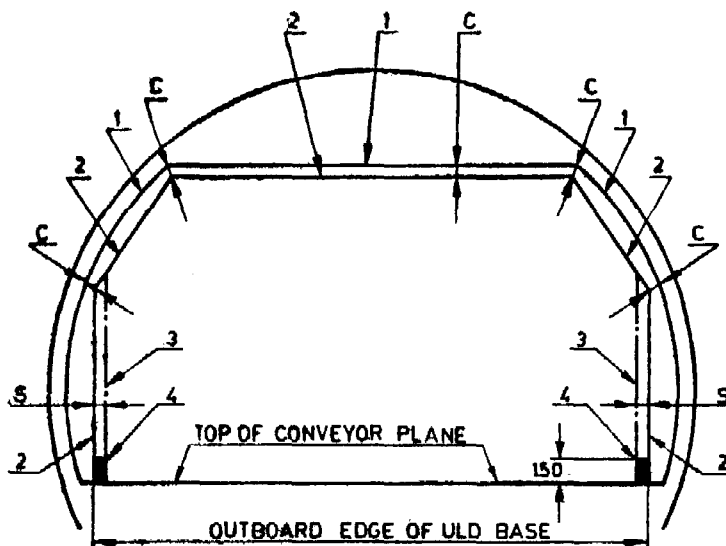


FIG. 7 MAXIMUM ALLOWABLE COUNTER

- 1) Minimum aircraft envelope through which the unit load device must pass.
- 2) Maximum allowable unit load device contour.
- 3) Maximum palletized cargo contour excluding net hardware, but shall not exceed contour (2).
- 4) This area (except for ULD base edge) to be left clear for aircraft and ground equipment restraint devices.

C = 50 mm : Minimum clearance.

S = 50 mm : Setback for palletized ULD.

3.1 Container Envelope — Construction are rigid unit loads devices, including both structural and non-structural igloo assemblies, with controlled contour shapes. The structural container and non-structural container/igloo shall allow 50 mm of clearance to the minimum aircraft envelope, as shown in Fig. 7.

3.1.1 Container volumes — The internal volume of the containers shall be listed as usable volumes, and shall be calculated by taking 93.5 percent of the external envelope volume. This will account for the floor, ceiling, sidewalls, internal stiffeners, longerons and supports. 93.5 percent is not applicable to fork liftable containers.

3.2 Pallets Load Envelope — A cargo pallet is a flat ULD, having no side or end walls, on which the cargo is stacked, and utilizes over-throw nets to secure the stacked cargo load. The palletized cargo contour shall allow 50 mm of clearance to the minimum aircraft envelope, except in areas where it is necessary to allow a greater clearance to protect critical aircraft components, in order to account for irregular shaped loads and load shifting which may occur. 50 mm of clearance does not apply to the net/hardware, but in no case shall the net/hardware be within 50 mm of the aircraft envelope. The palletized cargo shall also have 50 mm setback from the outer edge of the pallet on all sides to permit attachment of net hardware to the pallet (see Fig. 7). A 150 mm longitudinal clearance shall be provided for cargo in line with any aircraft structure unless that structure is designed to withstand bulk cargo restraint loads (see Fig. 8).

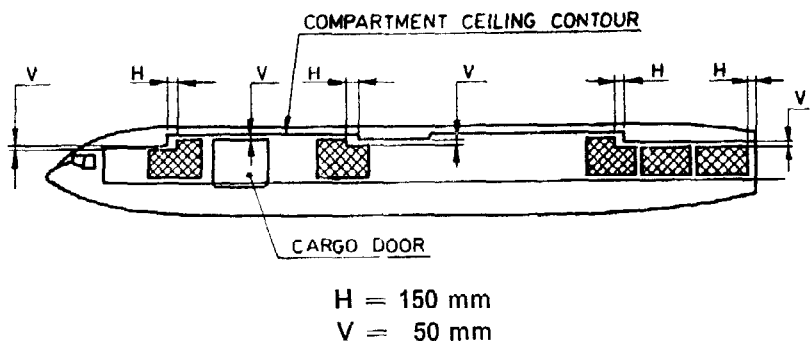


FIG. 8 PALLETIZED CARGO CONTOUR CLEARANCE

3.2.1 Palletized volume — The volume of a palletized ULD shall be calculated and listed as usable volume, utilizing the following guidelines. Pallet thickness shall be assumed as 19 mm for commercial pallet and 57 mm for military pallets, unless otherwise specified. The palletized cargo shall have a 50 mm setback from the outer edges of the pallet. The height shall be controlled by the 50 mm clearance dimension, to the minimum aircraft envelope through which the palletized ULD shall pass during the loading/unloading cycle (see Fig. 7). A 150 mm longitudinal clearance shall be provided for any change in contour shape due to overhead or sidewall protrusion in line with the ULD stowed position (see Fig. 8).

4. Package Size Chart — Package size charts or graphs shall be determined for each cargo compartment to define the maximum size rectangular shaped package which can be accommodated. The compartment length, width, height, door size and location are all influencing factors. The package size chart shall define the maximum package length in terms of package height and width and shall be similar to the example shown in Table 1. The height and width shall be in increments, not exceeding 25 cm, and the length shall be determined for packages in full contact with the compartment floor or conveyor system during loading/unloading operation and storage. A linear interpolation shall be permitted on any of the three dimensions or combination of any two dimensions. The charts shall be based upon a 50 mm minimum clearance between package and compartment interior envelope at all critical areas, such as door jambs, side-wall, ceiling and bulkhead. Tilting, twisting, bending, and/or rotating packages through the door opening will allow additional lengths in most cases, but these shall be determined for each special situation depending on allowable conditions and shall not be included in the package size charts.

TABLE 1 PACKAGE SIZE CHART (EXAMPLE)

(Clause 4)

All dimensions in centimetres.

<div style="display: inline-block; text-align: center;"> Height ↓ ↘ Width → </div>	Maximum Lengths for Various Heights and Widths										
	15	30	45	60	75	90	105	120	135	150	165
165	676	637	582	549	520	500	467	434	396	360	330
150	681	640	597	554	523	500	467	434	396	360	330
135	706	645	597	554	526	500	467	434	396	360	330
120	704	645	600	559	526	500	467	434	396	360	330
105	711	655	604	561	526	500	467	434	396	360	330
90	719	658	604	564	526	500	467	434	396	360	330
75	752	678	617	569	526	500	467	434	396	360	330
60	792	699	630	572	526	500	467	434	396	360	330
45	836	709	648	567	536	503	467	434	396	360	330
30	891	785	693	610	551	503	467	434	396	360	330
15	935	889	739	640	569	503	472	434	396	360	330

Note 1 — Lengths are determined for packages in full contact with the compartment floor during loading operations and storage. Tilting, twisting, bending, and/or rotating packages through door opening will allow additional lengths in most cases, but these shall be determined for each special situation depending on allowable conditions.

Note 2 — Package length for each combination of package width and height is a function of the aircraft door width, door height and the internal cross section of the compartment. A linear interpolation shall be permitted on any of the three dimensions or a combination of any two dimensions.

EXPLANATORY NOTE

The purpose of this standard is to establish a uniform methodology for defining and determining the usable internal volume of aircraft cargo compartments, and usable external envelope for Unit Load Devices (ULDs) which can be accommodated within these compartments. This will provide the aircraft industry with a set of standard terminology which when specified, can be utilized by the airlines when comparing similar type aircraft.

In order to facilitate international co-ordination on the subject, this standard is based on SAE/AS 1825 'Methodology of calculating aircraft cargo volumes', issued by the Society of Automobile Engineers (SAE).